Editors' Ready Reference Book on the Cement Industry and Concrete

"KNOW AMERICAN INDUSTRIES"

THE aim of this booklet is—

To furnish editors with a short, but complete history of the cement industry;

To give them authoritative facts and figures about the important uses of concrete;

To display ready reference tables on road mileages, highway maintenance costs, cement production and use, and various other matters that are frequently needed by newspapers, and usually difficult to find.

This booklet is sent you with the compliments of the Portland Cement Association on the one hundredth anniversary of the invention of portland cement.

Portland Cement Association

A National Organization to Improve and Extend the Uses of Concrete

111 West Washington Street

CHICAGO

OFFICES IN THIRTY CITIES

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ESTIMATED DISTRIBUTION OF PORTLAND CEMENT BY USES

(Percentages based on figures given in the 1922 U. S. Geological Survey Bulletin on Cement)

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Concrete pipe for water, sewers, irrigation and culverts	4.3
Paving and highways	24.0
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Bridges, river and harbor work, dams and water power projects, storage tanks and reservoirs	3.0
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	100.00

 

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A Brief History of the Portland Cement Industry in the United States

THE first effort to produce portland cement in the United States was made in 1872 when a plant was established at Coplay, Pennsylvania, by David O. Saylor. At that time imported portland cement was securing a strong foothold on the American market. In England, where the industry had been founded in 1824, decided progress had been made, but very little information pertaining to portland cement manufacture was available in this country.

Saylor had been making natural cement for some years before his venture into the portland cement field. His action in establishing a plant started other manufacturers experimenting and within a few years plants were being operated in various parts of the country.

Many interesting stories are told of the efforts of the early pioneers to perfect manufacturing methods. Saylor would carry pieces of rock home in his pocket and burn them in his cook stove in carrying out experiments. John K. Shinn, another early manufacturer in Pennsylvania, converted a bent car-axle into a primitive crusher by suspending it from a spring pole and bouncing it down on the raw materials.

A few months after Saylor's embarkation in the portland cement business, Thomas Millen of South Bend, Indiana, began the manufacture of the material. At that time Millen was engaged in making concrete sewer pipe, getting his cement from abroad. In experimenting with portland cement, Millen would drive into the country and dig a pail of marl from the lake region near Notre Dame, and a pail of clay from the river and carry them back to his pipe factory where he would mix and burn them in a piece of sewer pipe. He would grind in a coffee mill the product resulting from the burning and in a short time developed crude kilns and grinding machinery and manufactured portland cement for the United States government.


A modern rotary cement kiln in which the raw materials are burned to clinker.

During this early period, imported cement had become so popular that the American manufacturers had a difficult time selling their product. In fact, it was not until about 1900 that production of local cement surpassed the sale of imports.

The first portland cement mill west of the Mississippi River was not established until 1880, when the industry was started at San Antonio, Texas.

At the present time there are 127 operating portland cement plants in the United States.

A Brief History of Earlier Cements

LONG before the dawn of the Christian era people had been using cementing materials for a variety of building purposes. The Carthagenians erected an aqueduct in northern Africa seventy miles long several centuries before the Roman Empire was established. Vitruvius, architect for Augustus, wrote at length on the uses of cements and plasters, while the elder Pliny mentions cement a number of times in his writings. The tomb of King Tut-Ankh-Amen in the Valley of the Kings, Luxor, Egypt, has only recently disclosed examples of the early use of cementing materials.

All of these early cements were natural cements. In other words, nature was depended on for their formation. The Romans used slaked lime mixed with volcanic ash. They had discovered that such a mixture made a superior building material. They did not know why or how, nor did they understand the proportioning of the materials, or the part the volcanoes played in burning the rock.

One of the early cement kilns erected in England by William Aspdin about 1850.

The difference between these early cements and modern portland cement is that portland cement is a strictly manufactured product. Its composition is known at all times. Certain materials are pulverized, proportioned, mixed, burned at high temperature and reground to make a standard product. The Roman natural cements depended largely on nature for their proportioning, and on the volcanoes for the burning. There was no dependability and no consistency. Portland cement is a strictly uniform product.

During the Dark Ages the secret of the Romans apparently was lost. It was not until 1756 that an English engineer named John Smeaton found that an impure limestone containing a certain amount of clayey matter possessed the property of hardening under water when burned and reduced to powder. At the time, Smeaton was engaged in building a lighthouse on the Eddystone Rocks off the coast of Cornwall, and by using his new-found material he erected a structure that stood for years before it was torn down to make way for a larger one.

Following Smeaton's discovery other experimenters busied themselves in the cement field and various improvements were made. In 1824 Joseph Aspdin, a mason of Leeds, England, was granted a patent for a material he called "portland cement," because of its similarity when hardened to a rock quarried on the Isle of Portland. Aspdin's chief contribution was his discovery of the value of proportioning, mixing, burning and grinding the materials. However, it is doubtful if he really understood the chemistry of the process, and this field was extended by Isaac C. Johnson, also an Englishman. During this same period other men were engaged in cement research in France and Germany, and much valuable information was contributed by many of them.

THE NATIONAL FIRE LOSS

The annual fire loss in the United States, based on actual payments by fire insurance companies, according to Bradstreets, is as follows:

1919	$269,000,000
1920	331,000,000
1921	333,000,000
1922	411,000,000
1923	389,000,000

The per capita fire loss is around $3. In England it is 33 cents per capita; in France 49 cents; and in Holland, 11 cents. The figures for the United States probably represent only about 70 per cent of the entire loss, as uninsured buildings are not included.

During the last sixteen years the fire loss has been approximately one-fourth of the value of all new building construction.

In addition to the money loss, thousands of lives are lost every year in fires. For the ten years preceding 1920 this loss was about 23,000 a year.

What Is Portland Cement?

PORTLAND cement, instead of being the name of a particular brand of cement, is a commodity, like sterling silver or Paris green, that is produced by many different manufacturers. In the United States there are today some ninety companies making portland cement—now commonly known merely as "cement." Mixed with sand, stone and water it forms concrete, which is in effect "stone that you can mould."

The essential elements of portland cement are lime, silica and alumina. These are obtained in various combinations of raw materials, including cement-rock and limestone, limestone and clay or shale, marl and clay, and blast furnace slag and limestone.

Difference Between Portland and Natural Cements

The essential difference between portland cement and the old natural cements is that portland cement is a scientifically manufactured product the chemical constituents of which are carefully predetermined, while natural cements were made from the rock just as it came from the quarry. The rock was merely broken into pieces, heated to a comparatively low temperature, and then pulverized. These natural cements depended upon nature for their proportioning and mixing.

For portland cement, specific quantities of different ingredients are proportioned, pulverized and intimately mixed, burned at extreme temperature to hard clinker, and reground to extreme fineness. Standard specifications demand that cement be ground fine enough for at least 78 per cent of a given quantity to pass through a sieve with 40,000 holes to the square inch—a sieve that is finer than silk.

How Portland Cement Is Manufactured

PORTLAND cement manufacture is the art of taking definite proportions of raw materials, such as limestone, marl, shale, clay and blast furnace slag, grinding them to extreme fineness, burning them at a temperature that would melt steel, and regrinding the resulting clinker to a powder finer than flour. Over eighty operations are necessary before the cement is ready for market.

The first step is to secure the raw materials. Huge rocks from the quarry, marl from marl beds and clay from clay pits must be transported to the mills. Long before a plant is built, chemists test the deposits of materials in the field to assure a quantity that will warrant the establishment of an expensive mill.

The rocks are blasted loose in the quarry by high explosive, and steam shovels load them on dump cars for transportation to the mill. Huge gyratory or jaw crushers break lumps of rock the size of a piano into small fragments. Secondary crushers reduce them to still smaller pieces.

The modern cement plant contains a variety of crushing and grinding machinery. There are hammer mills, where hinged hammers batter the rock to bits, or centrifugal mills where the materials are crushed between steel rollers. Grinding is often done in ball or tube mills—armor plated cylinders half-filled with tons of steel balls. As the cylinder revolves, the balls roll over and over, reducing the material to fine powder.

Moving belts, bucket chains or screw conveyors carry the material from machine to machine in its trip through the plant.

Before final grinding prior to its entrance into the kilns, the material is exactly proportioned. Automatic scales, sealed and locked by the plant chemist, measure the proper amounts of each ingredient. In the fine grinding machines a thorough mixing takes place, and the properly proportioned powder goes to the kilns.

The modern rotary cement kiln operates similarly to a gigantic blow torch. The kilns are steel jacketed cylinders, lined with fire-brick and resting on their sides at a slight angle from the horizontal. Heavy gears rotate the kilns. One of the largest kilns when loaded for operation weighs as much as a train of ten steel Pullman cars and consumes a ton of pulverized coal every fifteen or twenty minutes. The powdered materials—or in wet process plants, the slurry—enters the upper end of the kiln and the rotation moves it toward the lower, or burning, end. Here a jet of burning coal dust, fuel oil or gas shoots into the kiln, for thirty feet or more. Temperatures of between 2,500 and 3,000 degrees Fahrenheit are produced. Several hours are required for the kiln burning and the material comes out as white-hot clinker, which when cooled becomes glass-hard pellets the size of marbles or walnuts. This clinker is cooled in cooling machines, and then goes to storage piles where it awaits final grinding. It is in the burning that a chemical change takes place that gives the material its cementing properties.

When the clinker is ground, a small amount of gypsum is added to regulate the setting time. Ground to a powder finer than flour the material is ready for the sacking machines.

Awaiting sacking, it is stored in huge concrete bins. The sacks are filled upside down, after they have been tied. This rather remarkable feature is due to the use of valve sacks. The cement enters the sack through a hole in the bottom, the flow being automatically cut off when the proper content of 94 pounds is inside. A valve flap over the hole keeps the contents intact.

Throughout the whole process of manufacture, frequent physical and chemical tests are made to insure a standard product.

The Portland Cement Association

What It Is, and How It Operates

IN the introduction to a book on "Trade Association Activities," recently published by the United States Department of Commerce, Secretary Herbert Hoover uses the following general definition of a trade association:

"A trade association is an organization of producers or distributors of a commodity or service upon a mutual basis for the purpose of promoting the business of its branch of industry or commerce and improving its service to the public. * * * The purpose and aim of a trade association then is to deal with all questions of general application in the branch of industry or commerce it serves, and so to develop its field that the enterprises in it may be conducted with the greatest efficiency and economy."

The organization which is now known as the Portland Cement Association, had its beginning in 1902, when a small group of cement manufacturers met in New York City to talk over problems of general interest. About a score of plants in the east were represented at the meeting. The result was the formation of a small trade association, and a secretary was employed to look after the general business.

From that small beginning the organization has developed until at present it is made up of a general office in Chicago and district offices in 30 representative cities. About 200 of the 350 employes of the organization are trained engineers. The membership includes 85 cement companies operating plants in the United States, Canada, Mexico, Cuba and South America. About ninety per cent of the American mills are members.

In cooperation with Lewis Institute, Chicago, the Association maintains a research laboratory devoted exclusively to cement and concrete research. Thousands of tests are made here and some 35 employes are busily engaged unearthing information that will be of assistance in getting maximum results with concrete.

In the general office there are a number of bureaus devoted to special phases of concrete work. Highways, cement products, agricultural uses, structural uses, railroad uses and housing are all covered by specialists. Latest developments are kept track of, and each bureau works in close cooperation with the district offices. These district offices have a trained engineer in charge with a number of fieldmen working throughout the territory. In this way individual contact is established with concrete users, and the information developed at the laboratory and in the general office bureaus is broadcast without charge to the people who use cement—whether it be a single sack or a million barrels.

A number of committees among the membership have proved their value in bringing about economies in production. Meetings of the entire membership are held twice a year, when these various committees report on technical problems, conservation, plant operation and other common matters. An Accident Prevention Bureau has been of untold benefit in keeping down accidents and instilling the idea of safety into the minds of the workmen. At the membership meetings technical papers are read which bring out many valuable items of information.

The Advertising and Publications Bureau at the general office has charge of all advertising, booklet preparation and literature distribution. There is scarcely a form of concrete work that has not been covered in a booklet prepared for free distribution.

In 1921 the Association, for the first time, experimented with newspapers as advertising mediums. The peculiar thing about Association advertising is that it is intended to sell an idea—not a product. No brand of portland cement is ever mentioned. The intention is merely to create a demand for cement—and it is then up to

Map showing offices of the Portland Cement Association.

the member companies individually to get the business. The use of newspaper space for advertising proved so surprisingly valuable, that the next year it was extended, and this year a larger number of papers have been added to the list. Obviously it is impossible to use all the papers in the country, but the Association is firm in its belief in the value of newspaper advertising and devotes a considerable appropriation for that purpose.

Special Features of Association Service

IMPROVEMENT news is live news, especially public improvements. Taxpayers are interested in knowing how their money is being spent, and what they are getting for it. And they look to the newspapers for such information. For that reason the newspapers will find the fieldmen of the Portland Cement Association valuable news centers, for these men are constantly in touch with what is being done throughout their territory, and what is contemplated. In a way they are reporters themselves, for it is their business to know what is taking place in the building and improvement field.

The Association, through its fieldmen or any of its district offices, can supply latest information on how various cities are handling their improvement problems, and what is being done in various parts of the country.

For the past several years an increasingly large number of newspapers have realized the value of attractive house plans for building pages or real estate sections, and have requested such material from the Association. Hundreds of pages of advertising of building products have been sold with these house plans as a nucleus. Mats of farm improvements have likewise been found desirable for farm sections, and many requests have been received for material of this kind. See pages 32 and 35.

Association fieldman assisting contractor with slump test to determine right consistency of concrete.

PORTLAND cement is now 100 years old. It was invented in 1824 by an English mason, who called it "portland" cement because of its resemblance, when hardened, to an English building stone quarried on the Isle of Portland. The first American plants for its manufacture were established 48 years later. Today the United States produces more portland cement than all the rest of the world combined.

A Research Laboratory for the Benefit of Cement Users

IN cooperation with Lewis Institute, Chicago, the Portland Cement Association maintains the Structural Materials Research Laboratory in the Institute buildings.

This laboratory is the only one in the country devoted exclusively to cement and concrete research. About 35 people are employed for this work and every year thousands of tests are carried out to develop information that will assist concrete users to get maximum results.

One of the features of the Laboratory is a "sand library" where over 2,800 specimens of sand are filed away in small glass bottles. There are sands from every section of the country and from a number of foreign lands. Every specimen has been tested as to its suitability in concrete work, and definite knowledge is at hand on just what can be expected from various kinds of sand.

Experiments at the Laboratory have brought out valuable information in regard to the water ratio in mixing concrete and it has been found that the amount of water used is just as important as the amount of cement.

Other experiments have covered the relative merits of different types of aggregates, the design of concrete mixtures, the effect of curing conditions of concrete, effect of fineness of cement, effect of age on strength of concrete, effect of time of mixing, and various other features that have added to general knowledge of concrete and its behaviour.

In addition to tests in the Laboratory, the work has been extended to cooperate with engineers and contractors right on the construction job. Recent examples of service, where laboratory experts conducted tests for individual projects, include the Tribune Tower, Chicago; the Big Four Railroad Bridge at Sidney, Ohio; a reinforced concrete flume for the Washington Power Co., at Spokane, Washington; concrete docks at Norfolk, Va.; concrete buildings at the U. S. Indian Irrigation Project, Blackfoot, Idaho; and many others.

This machine at the Structural Materials Research Laboratory is capable of subjecting concrete test specimens to a pressure of 200,000 lb.

Facts from the Laboratory are distributed through bulletins, lectures before technical and engineering societies, and through personal contact of the fieldmen. The Laboratory is the free service station of the cement industry. It is the recognized headquarters for information on cement and concrete. Because of it the fieldmen are able to give concrete users undisputed facts about how to use the material and get maximum results.

The Laboratory is a striking example of the benefits derived by modern industry and the public through scientific research.

PRODUCTION, SHIPMENT AND STOCKS OF PORTLAND CEMENT IN THE UNITED STATES

(Statistics from U. S. Geological Survey)

Year	Production (Barrels)	Shipments (Barrels)	Stock on Hand at End of Year (Barrels)
1870-1879	82,000	....	....
1880	42,000	....	....
1885	150,000	....	....
1890	335,500	....	....
1891	454,813	....	....
1892	547,440	....	....
1893	590,652	....	....
1894	798,757	....	....
1895	990,324	....	....
1896	1,543,023	....	....
1897	2,677,775	....	....
1898	3,692,284	....	....
1899	5,652,266	....	....
1900	8,482,020	....	....
1901	12,711,225	....	....
1902	17,230,644	....	....
1903	22,342,973	....	....
1904	26,505,881	....	....
1905	35,246,812	....	....
1906	46,463,424	....	....
1907	48,785,390	....	....
1908	51,072,612	....	....
1909	64,991,431	....	....
1910	76,549,951	....	....
1911	78,528,637	75,547,829	10,385,789
1912	82,438,096	85,012,556	7,811,329
1913	92,097,131	88,689,377	11,220,328
1914	88,230,170	86,437,956	12,773,463
1915	85,914,907	86,891,681	11,462,523
1916	91,521,198	94,552,296	8,360,552
1917	92,814,202	90,703,474	10,353,838
1918	71,081,663	70,915,508	10,451,044
1919	80,777,935	85,612,899	5,256,900
1920	100,023,245	96,311,719	8,833,067
1921	98,842,049	95,507,147	12,192,567
1922	114,789,984	117,701,216	9,267,238
1923*	137,377,000	135,887,000	10,581,000

*Subject to revision.

PRODUCTION OF PORTLAND CEMENT IN VARIOUS COUNTRIES FOR 1923

(United States figures from U. S. Geological Survey. Foreign figures estimated)

	Barrels
Belgium	10,000,000
British Empire	35,000,000
France and Colonies	12,000,000
Germany and Austria	30,000,000
Japan	12,000,000
All Others	30,000,000
Total	129,000,000
UNITED STATES	137,377,000
Grand Total	266,377,000

USE OF PORTLAND CEMENT PER CAPITA

(From U. S. Geological Survey Reports)

	Use of Portland Cement Per Capita (Barrels of 376 lbs.)	Percentage of Total U. S. Production Used by Each State
	1922	1922
Alabama	.41	.86
Arizona	1.69	.55
Arkansas	.28	.43
California	2.23	7.18
Colorado	1.11	.94
Connecticut	.86	1.09
Delaware	1.54	.30
District of Columbia	1.51	.57
Florida	.89	.79
Georgia	.36	.93
Idaho	.56	.22
Illinois	1.43	8.32
Indiana	1.30	3.35
Iowa	1.32	2.79
Kansas	1.50	2.32
Kentucky	.47	1.00
Louisiana	.49	.78
Maine	.60	.40
Maryland	1.03	1.33
Massachusetts	.76	2.62
Michigan	1.58	5.32
Minnesota	1.43	3.08
Mississippi	.24	.36
Missouri	.88	2.60
Montana	.44	.23
Nebraska	1.21	1.38
Nevada	1.18	.08
New Hampshire	.82	.31
New Jersey	1.53	4.40
New Mexico	.73	.23
New York	1.23	11.42
North Carolina	.86	1.96
North Dakota	.43	.24
Ohio	1.28	6.68
Oklahoma	.94	1.74
Oregon	1.15	.81
Pennsylvania	1.16	9.00
Rhode Island	.73	.39
South Carolina	.36	.54
South Dakota	.78	.44
Tennessee	.39	.81
Texas	.59	2.49
Utah	.95	.39
Vermont	.61	.18
Virginia	.60	1.23
Washington	1.23	1.51
West Virginia	.96	1.27
Wisconsin	1.68	3.94
Wyoming	1.09	.20
	Average 1.06	Total 100.00

TABLE OF CONCRETE HIGHWAY MILEAGE IN THE UNITED STATES COMPLETED AND UNDER TRAFFIC JANUARY 1, 1924

(All widths of pavement reduced to equivalent mileage of 18-foot width)

State	Built 1922	Built 1923	Total to End of 1923
Alabama	7	5	40
Arizona	155	51	414
Arkansas	14	34	160
California	299	164	3288
Colorado	37	28	137
Connecticut	34	42	249
Delaware	67	79	292
District of Columbia	½	..	8
Florida	31	48	106
Georgia	38	54	310
Idaho	13	⅛	36
Illinois	625	1041	2991
Indiana	177	265	1151
Iowa	101	95	439
Kansas	154	93	407
Kentucky	11	23	103
Louisiana	..	7	14
Maine	14	11	65
Maryland	85	129	863
Massachusetts	30	28	188
Michigan	234	319	1466
Minnesota	105	78	446
Mississippi	29	47	172
Missouri	82	139	327
Montana	..	..	27
Nebraska	18	19	55
Nevada	3	2	29
New Hampshire	4	3	8
New Jersey	112	117	530
New Mexico	18	7	59
New York	329	389	2243
North Carolina	127	336	595
North Dakota	1	½	4
Ohio	185	245	1403
Oklahoma	75	43	238
Oregon	44	35	199
Pennsylvania	461	365	2083
Rhode Island	5	7	33
South Carolina	41	20	140
South Dakota	..	1	1
Tennessee	..	17	58
Texas	91	55	366
Utah	42	10	217
Vermont	..	1	8
Virginia	38	114	497
Washington	118	92	980
West Virginia	57	95	517
Wisconsin	330	432	1652
Wyoming	..	..	13
Total for U. S.	4442	5194	25,627

SQUARE YARDS OF CONCRETE STREET PAVEMENT AWARDED IN CITIES WITH POPULATION OVER 100,000

	During 1923	End of 1923
3 Cities with Population Over 1,000,000		
New York	91,385	446,305
Chicago	71,248	365,313
Philadelphia	19,090	141,348
9 Cities with Population Between 500,000 and 1,000,000		
Detroit	31,146	605,010
Cleveland	32,170	268,167
St. Louis	42,221	117,928
Boston	15,973	46,068
Baltimore	100,495	718,185
Pittsburgh	36,242	75,837
Los Angeles	2,579,543	3,898,857
Buffalo	33,424	37,010
San Francisco	85,627	115,338
13 Cities with Population Between 250,000 and 500,000		
Milwaukee	232,651	393,701
Washington, D. C.	196,000	457,705
Newark, N. J.	2,180	58,843
Cincinnati	48,122	144,036
New Orleans	70,932	158,202
Minneapolis	12,140	294,940
Kansas City, Mo.	252,666	2,441,650
Seattle	507,600	1,744,863
Indianapolis	94,673	201,485
Jersey City	......	....
Rochester, N. Y.	8,000	8,990
Portland, Oregon	73,000	338,542
Denver	5,238	58,000
43 Cities with Population Between 100,000 and 250,000		
Toledo	101,975	495,366
Providence	......	....
Columbus, Ohio	......	7,298
Louisville	......	9,500
St. Paul	90,815	247,398
Oakland, Calif.	......	49,864
Akron	2,957	71,095
Atlanta	507,252	1,316,886
Omaha	314	314
Worcester, Mass.	17,412	66,762
Birmingham	8,412	38,412
Richmond, Va.	11,715	153,156
Syracuse	7,220	56,589
New Haven	20,800	295,928
Memphis	......	94,200
San Antonio	150	410,466
Dallas	94,011	298,399
Dayton	21,700	78,428
Bridgeport, Conn.	......	....
Houston	......	17,810
Hartford	18,366	86,206
Scranton	......	....
Grand Rapids	48,851	225,505
Paterson	......	11,374
Youngstown	95,897	291,194
Springfield, Mass.	......	120,771
Des Moines, Iowa	119,947	408,358

43 Cities with Population Between 100,000 and 250,000—Continued

	During 1923	End of 1923
New Bedford, Mass.	......	14,187
Fall River, Mass.	......	49,536
Trenton, N. J.	......	48,816
Nashville, Tenn.	......	64,911
Salt Lake City, Utah	......	162,523
Camden, N. J.	......	112,000
Norfolk, Va.	6,200	26,590
Albany, N. Y.	25,520	81,165
Lowell, Mass.	11,750	36,149
Wilmington, Del.	7,466	80,652
Cambridge, Mass.	......	....
Reading, Pa.	......	2,584
Ft. Worth, Texas	......	25,023
Spokane, Wash.	51,498	352,040
Kansas City, Kansas	140,000	628,505
Yonkers, N. Y.	......	131,028

FEDERAL AID PROJECTS COMPLETED AND UNDER CONSTRUCTION 1916 TO JANUARY 31, 1924

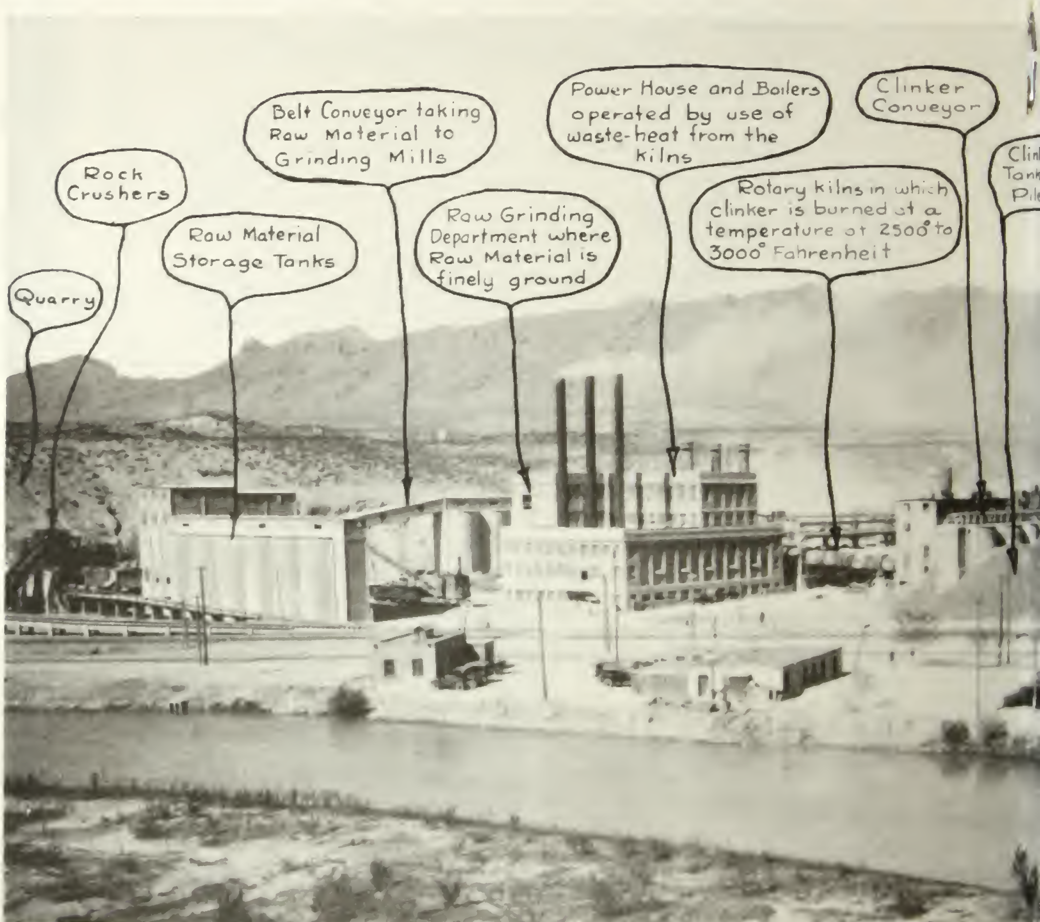
(Compiled from Statistics of the U. S. Bureau of Public Roads)

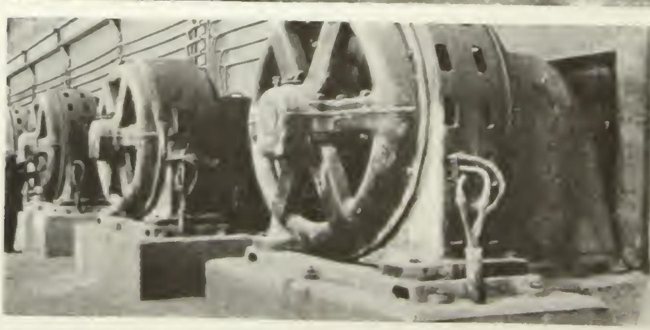
Type	Cost	Percentage of Total Cost	Mileage	Percentage of Total Mileage
Concrete	**$316,101,897.62**	**38.4**	**8,353.7**	**18.0**
Brick	31,083,826.40	3.8	715.7	1.5
Bituminous Concrete	43,388,634.82	5.3	1,227.2	2.6
Bituminous Macadam	79,264,824.36	9.6	2,668.4	5.7
Waterbound Macadam	27,405,486.08	3.3	1,439.1	3.1
Gravel	184,140,823.53	22.4	17,860.5	38.3
Sand Clay	33,242,643.80	4.0	4,599.1	9.9
Graded	80,958,032.34	9.8	9,622.2	20.6
Bridges	27,871,097.07	3.4	83.3	0.2
Total	$823,457,266.02	100.0	46,569.2	100.0

SUMMARY OF STATE HIGHWAY BOND ISSUES AUTHORIZED NOVEMBER, 1918 TO JANUARY 1, 1924

State	Amount	Year Authorized
Alabama	$ 25,000,000	1922
California	40,000,000	1919
Colorado	6,000,000	1920
Colorado	5,000,000	1922
Idaho	2,000,000	1920
Illinois	60,000,000	1918
Maine	8,000,000	1919
Maryland	3,000,000	1920
Maryland	4,000,000	1922
Michigan	50,000,000	1919
Missouri	60,000,000	1920
Nevada	1,000,000	1919
New Jersey	40,000,000	1922
New Mexico	2,000,000	1921
North Carolina	50,000,000	1921
Oregon	12,500,000	1919
Oregon	6,180,000	1920
Oregon	7,000,000	1921
Pennsylvania	50,000,000	1918
Pennsylvania	50,000,000	1923
South Dakota	4,500,000	1919
Utah	4,000,000	1919
West Virginia	50,000,000	1920
Wyoming	2,800,000	1919
19 States	$542,980,000	

Following Raw Materials Thr

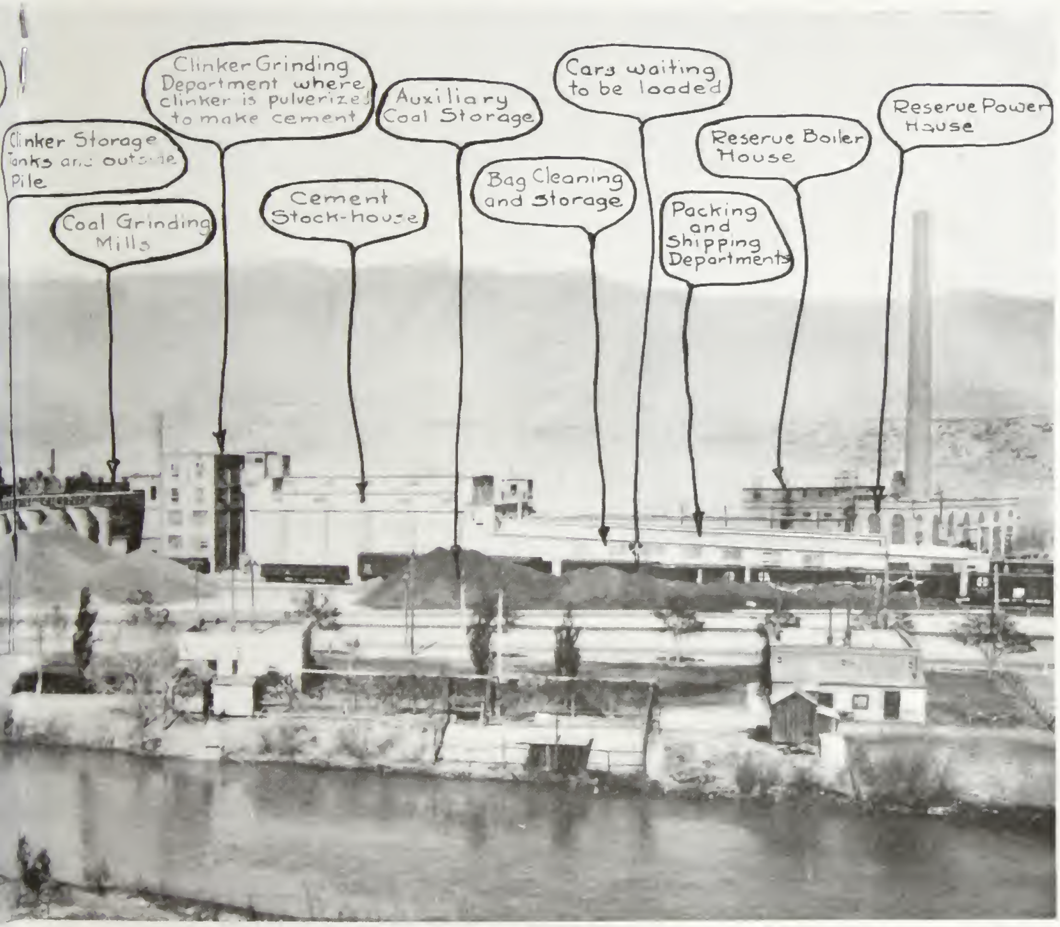


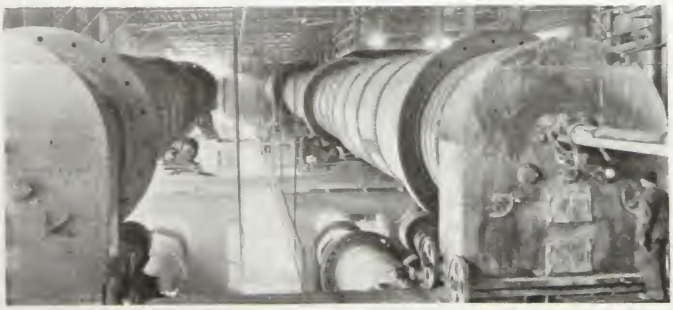


Grinding solid rock and glass-hard clinker demands an enormous amount of power.

Steam shovels in the quarries pick
rock at each

hrough a Typical Cement Mill





...es pick up several tons of the blasted ...at each bite.

A single rotary cement kiln may weigh as much as a locomotive and eight steel Pullman cars.

SUMMARY OF STATE AND COUNTY HIGHWAY BOND ISSUES AUTHORIZED NOVEMBER, 1918 TO JAN. 1, 1924

State	Amounts	State	Amounts
Alabama	$ 31,100,000	Nebraska	$ 3,000,000
Arizona	13,475,000	Nevada	1,200,000
Arkansas	4,900,000	New Hampshire	....
California	70,439,000	New Jersey	45,359,000
Colorado	11,000,000	New Mexico	2,325,000
Connecticut	35,000	New York	5,567,947
Delaware	2,040,000	North Carolina	69,759,000
District of Columbia	....	North Dakota	....
Florida	12,255,000	Ohio	....
Georgia	17,125,000	Oklahoma	10,511,000
Idaho	12,075,000	Oregon	42,918,604
Illinois	76,430,845	Pennsylvania	140,453,237
Indiana	1,860,000	Rhode Island	....
Iowa	19,275,000	South Carolina	20,735,000
Kansas	50,000	South Dakota	4,500,000
Kentucky	9,140,000	Tennessee	9,855,000
Louisiana	14,338,000	Texas	125,240,500
Maine	8,073,000	Utah	8,809,500
Maryland	9,600,000	Vermont	75,000
Massachusetts	42,000	Virginia	3,231,000
Michigan	54,210,000	Washington	10,003,000
Minnesota	18,582,000	West Virginia	67,990,500
Mississippi	18,719,000	Wisconsin	37,391,000
Missouri	76,339,600	Wyoming	4,600,000
Montana	7,283,000		
		Total	$1,101,910,733

What Goes Into a Mile of Concrete Road?

A MILE of concrete pavement as ordinarily constructed, 18 feet wide, will require 2000 cubic yards of mixed concrete. This means that 3400 barrels of portland cement, 1100 cubic yards of sand and 1600 cubic yards of stone must be supplied and mixed.

In making 3400 barrels of portland cement some 340 tons of coal, or equivalent quantities of oil or gas, are burned at the cement mill. Approximately 19 tons of gypsum are required to regulate the setting time of the material. To get the cement shipped to the construction job, 13,600 cloth cement sacks are needed—and approximately 13 bales of cotton must be woven into cloth to supply this item. Incidentally, over 60,000,000 cloth cement sacks are lost or destroyed each year and the textile industry is called on to furnish replacements. Back in the cement quarries approximately 400 pounds of dynamite were discharged in blasting loose the raw materials required for the cement for the mile of highway.

A government bulletin estimates that 30 gallons of water are needed to mix and cure a square yard of concrete pavement. Over 300,000 gallons of water must be furnished for the mile of road, and over 4,000 tons of concrete go into the project.

A good idea of what the highway construction business means to the railroads can be obtained from the requirements of a mile of concrete road. About 32 cars of sand are needed on this job, 46 cars of stone are required, and it takes 17 cars to haul the cement—or 95 cars for the basic materials. Where reinforcing is specified, further transportation is called for, while the water supply is governed by local conditions. In addition to these requirements the drainage, grading, bridge and culvert construction must all be provided for.

TOTAL MILEAGE AND MILEAGE OF SURFACED ROADS IN UNITED STATES, JANUARY 1, 1924

State	Total Mileage	Miles of Surfaced Road* January 1, 1923
Alabama	58,410	10,778
Arizona	21,227	1,646
Arkansas	74,866	4,744
California	75,889	15,263
Colorado	48,143	6,230
Connecticut	12,152	2,374
Delaware	3,933	528
District of Columbia	......	......
Florida	27,643	6,876
Georgia	94,000	19,060
Idaho	31,099	3,597
Illinois	96,326	12,435
Indiana	76,246	42,292
Iowa	104,082	3,424
Kansas	128,552	1,372
Kentucky	68,704	16,039
Louisiana	39,803	3,527
Maine	21,483	3,303
Maryland	14,772	3,835
Massachusetts	18,868	6,811
Michigan	77,283	19,756
Minnesota	107,103	18,982
Mississippi	53,085	6,357
Missouri	111,520	8,346
Montana	64,732	1,901
Nebraska	86,556	656
Nevada	26,057	249
New Hampshire	13,841	1,837
New Jersey	14,061	6,824
New Mexico	45,549	2,101
New York	81,878	20,210
North Carolina	68,204	18,871
North Dakota	106,523	853
Ohio	84,219	37,272
Oklahoma	134,263	2,648
Oregon	45,475	9,028
Pennsylvania	90,991	14,863
Rhode Island	2,274	840
South Carolina	61,850	7,456
South Dakota	115,485	874
Tennessee	62,546	10,604
Texas	167,685	16,986
Utah	23,047	2,987
Vermont	14,677	3,693
Virginia	59,080	7,815
Washington	45,816	12,872
West Virginia	35,173	1,558
Wisconsin	78,679	21,672
Wyoming	46,528	578
	2,940,378	422,724

*Includes gravel and sand-clay surfaces or better.

Figures from National Motorists Association.

Total mileage certified by States, 2,886,061; Certified for Federal Aid, 168,881.

ROAD MAINTENANCE COSTS IN NEW YORK

(Figures compiled by New York State Highway Department, Albany, N. Y.)

The following table gives the average annual cost of maintenance of various types of paved highway in New York for the years 1918-1922, inclusive —classified according to the volume of traffic.

Average No. of Vehicles per 12-hour Day	Miles		Cost of Maintenance per Mile per Year Pavement Only	Total Maintenance Including Shoulders and Ditches
First Class Concrete Pavement 1:2:4 Mix or Better				
Less than 500	114.61		$ 62	$172
500 to 1000	158.28		54	152
1000 to 2000	199.46		76	226
Over 2000	98.28		149	402
Total	570.63	Average	$ 80	$230
Brick Pavement				
Less than 500	31.35		$165	$414
500 to 1000	64.33		99	199
1000 to 2000	62.69		109	219
Over 2000	87.77		279	493
Total	246.14	Average	$174	$337
Mixed Bituminous Macadam on Concrete Base				
Less than 500	7.66		$ 99	$300
500 to 1000	22.65		146	231
1000 to 2000	30.39		146	298
Over 2000	29.02		229	336
Total	89.72	Average	$169	$293
Mixed Bituminous Macadam on Macadam Base				
Less than 500	12.87		$375	$473
500 to 1000	5.90		513	612
1'000 to 2000	7.48		302	484
Over 2000	17.89		544	913
Total	44.14	Average	$449	$673
Bituminous Macadam Penetration Method				
Less than 500	947.41		$303	$429
500 to 1000	1050.61		355	499
1000 to 2000	798.03		409	612
Over 2000	317.09		646	889
Total	3113.14	Average	$382	$547
Waterbound Macadam				
Less than 500	1111.72		$551	$658
500 to 1000	763.26		652	843
1000 to 2000	360.12		692	897
Over 2000	38.51		881	1110
Total	2273.61	Average	$615	$766
Gravel Surface				
Less than 500	110.76		$584	$737
500 to 1000	31.49		721	924
1000 to 2000	6.62		675	872
Over 2000	.60		824	983
Total	149.47	Average	$622	$785
TOTAL OF ALL TYPES				
Less than 500	2384.17		$422	$543
500 to 1000	2181.23		438	595
1000 to 2000	1522.76		422	618
Over 2000	611.04		495	735
	6699.20	Average	$433	$595

How the United States Geological Survey Describes the Work of the Portland Cement Association

(Reprinted from "Cement in 1922," published by the U. S. Geological Survey, Department of The Interior.)

"One of the features of the year 1922 was the commemoration in November of the twentieth anniversary of the Portland Cement Association. The Geological Survey has since 1910 enjoyed helpful cooperation in statistical and scientific studies from this association, and a few facts concerning its growth and work will be of interest. It began in 1902, when a group of about 20 cement manufacturers met in Philadelphia to consider the cement-sack problem. Within a year common interests drew into the organization producers of 90 per cent of the output of portland cement in the United States, and at present more than 95 per cent of the domestic output is represented by membership in the association, which now extends also to manufacturers in Canada, Mexico, Cuba, Argentina, and Uruguay.

"From a single paid employe in 1902-1905 the staff of the association has grown into one of the largest engineering, educational, and scientific research organizations in the world and at the end of 1922 comprised 342 employes, more than 200 of whom were trained engineers. Twenty-four district offices are maintained, one of them in Canada, for the purpose of rendering to the public, free, the utmost service and advice concerning the economical and efficient utilization of cement and concrete. A structural materials research laboratory is maintained at Lewis Institute, Chicago, which has carried its investigations far beyond those possible to Government laboratories at the present time.

"The Portland Cement Association is doing work of so many kinds that to enumerate them in detail here would require too much space, but it is rendering so broad a service to the public that a brief outline of its activities and publications may well be furnished by the Geological Survey, which has occasion continually to refer correspondents to the association for data that are commonly believed to be obtained by the Government.

"The general subjects of papers distributed by the Portland Cement Association during 1922 included various phases of concrete roads, streets, alleys, pavements, bridges, schoolhouses, homes, swimming pools, mercantile and industrial buildings, fireproof buildings, chimneys, garages, coal pockets, grain tanks, railway-track supports, oil tanks, drainage tile, sewer pipe, silos, manure tanks, septic tanks, foundations, concrete block and brick, fence posts, making and use of concrete, storage of cement, and many miscellaneous subjects. It also issued periodical publications devoted to highways and construction."

The Bates Experimental Road

THE State of Illinois is engaged in the construction of a highway system which will have a length of about 5000 miles and will cost about $100,000,000. To undertake a program of that magnitude without definite knowledge of the type and design of pavement best able to carry legal traffic under the conditions existing in the state seemed unwise; so early in 1920 the state highway officials decided to pave a road and test the pavement by driving trucks over it until it was destroyed.

The location selected for the test road is typical of a large part of the middle west. It is in the heart of the corn belt, a few miles from Springfield, Ill. Concrete, brick and asphalt were the paving materials selected for the test. With each of these materials, sections varying from thin to thick, and having various foundation courses were built, so that nearly every design that has been advocated in the United States was represented. There were 63 of these sections, each from 100 to 250 feet long. Construction was started in June, 1920, and finished in July, 1921. Traffic tests were not begun until March, 1922. Three-ton army trucks with solid tires were used, making regular, timed trips up one side and down the other of the road. Beginning with the bare chassis, the load was increased until the maximum legal load for the state was exceeded by 66 per cent.

The results of the tests, as contained in reports of the state highway department, show that of the 22 sections of brick, 17 of asphalt and 24 of concrete, 4½ per cent of the brick, 17⅔ per cent of the asphalt and 41⅔ per cent of the concrete successfully sustained all the imposed traffic.

In 1923, Illinois constructed over 1000 miles of concrete pavements.

Tractive Resistance Tests

A SERIES of tests conducted by A. N. Johnson with the cooperation of the White Company, Cleveland, Ohio, to bring out facts regarding the resistance of different types of pavement to motor vehicles, resulted in the following results:

Kind of Road	Condition	Miles per Gallon
Concrete	Good	11.78
Brick	Extra smooth	11.44
Brick	Fair—somewhat worn	9.88
Bituminous macadam	Fair—somewhat worn	9.48
Gravel	Good	9.36
Gravel	Fair	7.19
Earth	Clay—a little mud—fair condition	5.78

In conducting these tests, White trucks were used, carrying a load of two tons and running at a speed of 15 miles per hour. On concrete the trucks averaged 11.78 miles per gallon. The gasoline consumption on dirt roads was 104 per cent greater than on concrete.

Power Consumption on Various Types of Roads

TESTS which have been made by the Engineering Experiment Station of the Iowa State College on the effect of road surfaces on gasoline consumption show that the better types of roads materially decrease the consumption of gasoline. The average results of the investigations were as follows:

On earth	14	ton-miles per gallon
On gravel	21	" " "
On bitulithic	28.5	" " "
On brick	29.7	" " "
On concrete	**31**	" " "

It is logical to assume an equivalent comparative mileage per battery for electric trucks. If 35 miles per battery charge is the mileage secured on an earth road the mileage secured on other surfaces would be as follows:

	Mileage per Gallon in per cent of Mileage on Earth Road	Miles per Battery Charge
Earth	100	35
Gravel	150	52½
Bitulithic	203	71
Brick	212	74
Concrete	**221**	**77½**

(Tables published in the Commercial Car Journal, Dec. 15, 1923)

Cost Per Mile for Cars in Rental Service Without Drivers

	Cost per Mile on	
Kind of Car	Earth Roads	Concrete Roads
Ford Touring	$0.093	$0.069
Ford Coupe	.094	.070
Ford Sedan	.095	.072
Dodge Touring	.115	.091

IT will be seen from this table that there is a practically uniform saving of 2.4 cents per mile on the total cost of operation over concrete roads as against dirt roads. In terms of percentage this saving runs from about 21 to 25 per cent, depending on type of car. For 12,000 miles the saving totals $288, which is important to any car owner, and especially so to the owner of a small car.

The figures above were furnished by R. A. Balcom, proprietor of The General Tire Company, Springfield, Ill. When this company engaged in the "Hire a Car and Drive It Yourself" business, a complete cost record system was devised, and certain cars were assigned to dirt road trips while others were used on concrete roads. These figures were based on operations after all cars had been driven over 12,000 miles. Costs included gasoline, oil, tires, repairs, depreciation, interest on the investment, cleaning and housing.

How Much Can a Horse Pull?

TESTS recently conducted by the Horse Association of America show that to start a farm wagon, weighing with its load more than 7700 pounds, there is needed a pull of

125 pounds on a concrete road, or 32.5 lb. per ton
200 pounds on a brick road, or 51.9 lb. per ton
300 pounds on an asphalt road, or 78 lb. per ton
520 pounds on a good dirt or cinder road or 135 lb. per ton

An editorial in the Salt Lake City, Utah, Tribune, of October 7, 1923, says:

"A series of experiments conducted by the Horse Association of America (Iowa State Fair, Des Moines, Sept., 1923) resulted in demonstrating that a horse may develop as much as twenty horsepower in an emergency. The tests were made with an apparatus invented for the purpose of finding out how much a horse can pull. The tests showed a team of good horses can exert a tractive pull of 2000 pounds, or enough to lift a ton vertically. Such pulls as these are not needed on ordinary roads. It was shown that on a concrete road surface the amount of pull required to start a farm wagon weighing with its load more than 7700 pounds, was only 125 pounds.

"The influence of the road surface was demonstrated by additional experiments which showed that to start the same load on a good brick road required a pull of 200 pounds, while 300 pounds were required on an asphalt surface and 520 pounds on a good dirt or cinder surface. In other words, the same team can pull four times as much on a concrete road as it can on the best surfaced dirt road.

"The new tests emphasized the value of breeding and training in horses and have opened up new possibilities, their inventor says, in the direction of scientific measurement of performance of differing breeds and individuals. While the value of weight in draught animals was again demonstrated, a surprising result of the tests was that gameness counted almost as much. A little broncho team, weighing 455 pounds less than its competitors, pulled larger loads in proportion to weight than any other team entered in the tests in any class. More extended tests will be made next year."

Lighting Standards

Sooner or later the question of street lighting is sure to be a live issue in every progressive city. The newspaper interested in campaigns for better street lights will find valuable information in the experience of the following cities, where concrete lighting standards have been widely used.

Milwaukee, Wis.
Rochester, New York
Denver, Colo.
Detroit, Mich.
Indianapolis, Ind.
Chicago, Ill.
Fond du Lac, Wis.
Beloit, Wis.
Pittsburgh, Pa.
Knoxville, Tenn.
Oshkosh, Wis.
Racine, Wis.

Concrete Products

A large percentage of the annual cement production is used in the manufacture of concrete products, such as concrete building block, brick and tile, pipe, silo staves, roofing tile, etc.

At the beginning of 1924 there were approximately 6000 manufacturers engaged in producing concrete products of all types.

During 1923 approximately 5000 concrete block houses, surfaced with portland cement stucco, were erected in the eastern states alone.

Production of Concrete Block

1921	175,000,000
1922	300,000,000
1923	385,000,000

These figures are for the equivalent of block 8 by 8 by 16 inches.

In 1922 approximately 10,000,000 light-weight building tile were manufactured in the United States. In 1923 this figure jumped to 20,000,000.

In 1923 approximately 150,000,000 concrete brick were produced in this country.

Concrete Silos

There are approximately 400,000 concrete silos on American farms at the present time. Of this number about 100,000 are located in the state of Wisconsin, which fact is largely responsible for the prosperity of Wisconsin dairy farmers. Conservative figures show that a silo pays about 40 per cent profit, and frequently pays for itself in one year.

In Kane County, Illinois, where there are 2000 farms, there are 2000 concrete silos.

Concrete Pipe

While concrete pipe has been generally used in the United States and foreign countries for over eighty years, the greatest progress has been made during the last twenty years. It has been used for building storm and sanitary sewers, railroad and highway culverts, irrigation water supply lines and for drainage systems.

Sewer pipe is manufactured in two classes—plain and reinforced. Plain pipe is produced in standard sizes from 4 to 24 inches, and reinforced pipe in sizes from 24 to 108 inches internal diameter. One company has sold over 500 miles of reinforced pipe for sewer construction alone.

Concrete irrigation pipe has been extensively used for irrigation purposes in the arid regions of the country. The state of California has installed at Delhi, a system which required 200 miles of pipe from 12 to 36 inches internal diameter. Such pipe is used widely by the U. S. Reclamation Service. A prominent engineer of Berkeley, California, has estimated that over 25,000 miles of concrete pipe have been used in the construction of irrigation systems in California alone during the past thirty years.

The use of concrete pipe for water supply systems has been largely confined to sizes above 12 inches internal diameter. There are a number of lines in existence operating under heads from 10 to 150 feet. Some of the installations are the Sooke Lake Aqueduct near Victoria, B. C., consisting of 27 miles of 42-inch pipe; a portion of the Winnipeg Aqueduct consisting of 12½ miles of 48 to 66-inch reinforced concrete pipe; Baltimore, Md. (tunnel lining), consisting of 1½ miles of 84 to 108-inch pipe.

Large jobs have been installed at Norfolk, Va.; Cumberland, Md.; Denver, Colo.; Fort Worth, Texas.; Pendleton, Oregon, and in Tulsa, Okla., where 52 miles of 54 and 60-inch pipe were required to supply water for the city. The actual value of the pipe alone for this job was $3,000,000.

Largest Concrete Structures

Office Buildings

The 21-story United Brethren building in Dayton, Ohio, is the tallest concrete building in the world. The Medical Arts building in Dallas, also a concrete structure, is 19 stories high.

Concrete in the Army and Navy

The U. S. Navy supply base at Brooklyn consists of four buildings and a power house with a combined floor area of 2,275,000 square feet. It was designed to house 70,000 tons of supplies.

The Army supply base at Brooklyn has a floor area of 4,100,000 square feet. Both are concrete projects.

Wireless Tower

The concrete wireless tower at Tokyo, Japan, is 672 feet high and is the tallest tower in the world. During the Japanese earthquake this tower, although on the edge of the quake zone, withstood the shocks without damage and was used to send out messages describing the disaster.

Concrete in the Panama Canal

Over 5,000,000 cubic yards of concrete were required in the construction of the Panama Canal.

Railroad Viaduct

The Tunkhannock Creek viaduct, completed in 1915 by the Delaware, Lackawanna and Western Railroad in Pennsylvania, is the largest structure of its kind in the world. This viaduct is 240 feet high and 2375 feet long. Approximately 370,000 cubic yards of concrete and 2360 tons of reinforcing steel were used. The cost was approximately $12,000,000.

Dam

The Wilson Dam at Muscle Shoals has a total length of 4111 feet. The dam crest is 80 feet above the elevation of the river bed and will carry gates 18 feet high.

Chimney

The highest concrete chimney in the world is located at a smelter plant at Sagonoseki, Japan. It is 570 feet high and 42 feet 8 inches wide at the base.

Overfall Dam

The highest overfall type of dam, constructed of solid concrete is located on the Yadkin River near Baden, N. C. It is 1400 feet long and 217 feet in maximum height. It contains 525,000 cubic yards of concrete and is a part of a hydro-electric development.

Suggestions for Avoiding Difficulties Caused by the Seasonal Nature of the Construction Industry

(A reprint of pages 242-243, "Cement in 1922," published by the U. S. Geological Survey, Department of the Interior.)

"A recent article offers some pertinent advice to show how dealers and users can help to avoid a shortage of cement at the time of peak demand, as well as to help relieve the congestion in freight shipments, and enable the portland cement mills to maintain a more steady rate of production through the simple expedient of ordering early the cement that they will need later and storing it for use when transportation difficulties make prompt deliveries impossible.

"It is pointed out that manufacturing capacity cannot be made adjustable to the spasmodic demands of the building industry, and that, although the mills of the country may be able, for example, to produce 12,000,000 barrels in one month, it is not possible for them to produce 24,000,000 barrels in one month to make up for shutdowns in some other month. Manufacturers cannot afford to make and store a large quantity of cement for which they have no immediate demand, although many of them have done so in the early part of the year, a practice that entails the tying up of a large amount of capital and naturally has its effect on the price of cement.

"Beyond the accumulation of a safe reserve, the storage of finished cement by the manufacturers in winter for shipment later in the year tends to complicate the transportation situation, because the heaviest movement of crops, building material, and coal comes in the summer and fall, when the demand for railroad facilities exceeds the supply, so that car shortages are bound to occur, even though the railroad equipment is in good order. Dealers and contractors therefore find it advantageous to order and store cement early in the year, but in order to do this intelligently they must have some idea what their requirements will be, for portland cement cannot be stored indefinitely, and to this end they must have the cooperation of the architect, engineer, and banker. If all these forces are set in motion early in the year, much may be accomplished toward distributing the demand over a longer period of the year.

"A good step in this direction has been taken by several State highway departments, notably those of Indiana and Illinois, by inserting in their contracts the provision that a certain percentage of the cement required to complete each job must be kept in stock by the contractor. This provision should help materially to keep road work going in times of car shortage, but road work is handicapped because in most States it cannot be carried on during the winter like some other kinds of construction work."

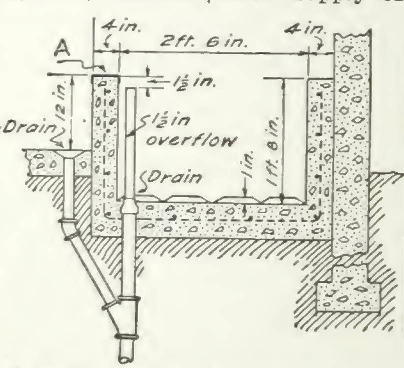
Mats of Farm Improvements

A series of twenty short, illustrated features on farm improvements, prepared in mat form, can be had by any newspaper by merely asking for them from the nearest Association district office. One of the mats is reproduced on this page. Others cover fire-safe chimneys, dairy barns, smokehouses, storage cellars, farm ice houses, and other improvements that help the farmer with his daily labor.

Cooling Vats Aid Dairy Business

MODERN dairying demands concrete construction in almost all necessary equipment, whether it be the buildings, the floors, walls, or cooling tanks. Sanitation and cleanliness are essential if the dairy is to show a profit. In many localities laws provide that dairy buildings shall be of a thoroughly sanitary type and concrete has demonstrated that it is the most successful all-purpose material meeting these requirements.

An almost indispensable adjunct to the milk house is a cooling tank, which is built essentially in the same manner as a stock watering trough. Inlet and overflow fittings should be provided, with proper consideration for the depth of water to be maintained in the tank so that cans will be kept submerged to well up around their necks. Grooves cast in the bottom of the tank while its floor is being concreted will provide for adequate circulation of water under the cans. These grooves can be formed by pressing several triangular strips of wood into the concrete before it has hardened, and afterward removing them.



A cooling vat is a necessary adjunct where dairy products are handled.

Frequently an ice house and milk room are combined. With a home supply of ice available, the content of the tank can be kept cool by keeping chunks of ice in it. Otherwise spring water may be circulated through the tank.

Often a spring is inclosed with a concrete building which becomes the milk house after the spring has been properly walled with concrete.

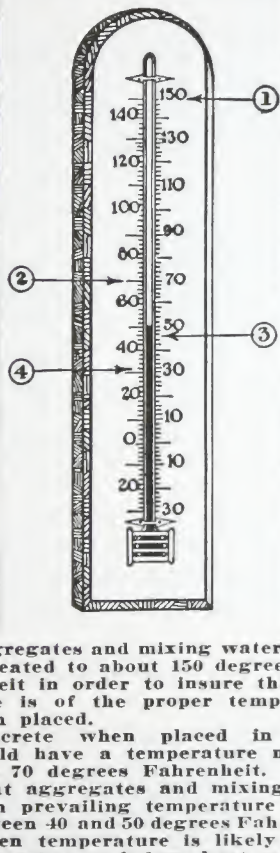
It has been estimated that at least 30 per cent of such dairy products as milk and cream is wasted on the farm due to lack of or insufficient cooling facilities. The products spoil before they can be marketed. These figures are based on careful studies of the United States Department of Agriculture and enable anyone to prove to himself that the cost of a milk house is soon returned through prevention of waste.

For a tank 8 feet long the following materials will be needed: 6½ sacks of cement; 13 cubic feet sand; 20 cubic feet of pebbles; 170 feet of ¼-inch steel rods. Mix in following proportions: 1 part cement, 2 parts sand, 3 parts gravel.

How to Place Concrete in Cold Weather

The fundamental thing to know about placing concrete in cold weather is that concrete must not freeze before it hardens. Although it is easy to keep concrete from freezing it would be better not to start any farm improvement in freezing weather unless the proper precautions are to be taken to protect the fresh concrete from the cold. However, if these precautions are taken there is no reason why farm improvements with concrete should not be carried out regardless of the low temperature.

Since warmth and moisture are required for the proper hardening of concrete, cold weather work should be planned with these necessities in view. Both the mixing water and the aggregates should be heated. The cement forms such a small portion of the bulk of concrete that it need not be heated, but it is well to keep it in a warm place for a few hours before it is used.



1—Aggregates and mixing water should be heated to about 150 degrees Fahrenheit in order to insure that concrete is of the proper temperature when placed.
2—Concrete when placed in forms should have a temperature not less than 70 degrees Fahrenheit.
3—Heat aggregates and mixing water when prevailing temperature ranges between 40 and 50 degrees Fahrenheit.
4—When temperature is likely to fall to freezing or below, heat materials and protect concrete from freezing. Warm forms. Remove all snow and ice. Leave forms in place until concrete is strong enough to be self-supporting.

The nearer the water is to the boiling point, the better. There are several methods used for heating aggregates. A simple arrangement that any farmer can contrive is a metal cylinder similar to a corrugated road culvert over which the sand, broken stone or pebbles can be piled and in which a fire can be built. Care must be taken to heat the fine and coarse aggregates separately in order to avoid premixing them in the wrong proportions. If the materials are heated as above outlined and the concrete is deposited immediately after mixing, its temperature when placed in the form will be around 80 degrees and if care is taken to prevent the too rapid loss of this contained heat, the concrete will harden properly.

In placing concrete in cold weather the forms must be free from snow, ice and frost. After the concrete is placed it should be protected while hardening so as to maintain the warm moist condition essential for the rapid development of strength. There are many ways of doing this. A layer of clean straw or hay will furnish sufficient protection for some classes of work. Where the job can be enclosed, open coke stoves or salamanders may be used. In severe weather, such protection should be continued for at least five days. The concrete should be protected as soon as placed in order to retain the heat.

Care should be taken that the concrete is strong enough to bear a load before the forms are removed. This can be determined by pouring hot water on the concrete to be sure that the concrete has hardened and not merely frozen.

The "Home, Sweet Home" House in Washington, D. C.

AS the feature of the Better Homes Movement in 1923, the General Federation of Women's Clubs constructed a house similar to the Long Island cottage that inspired the famous song, "Home, Sweet Home," written by John Howard Payne in 1823. The reproduction was erected in the nation's capital across from the White House and many government officials, including President Harding, took part in the dedicatory exercises.

Preliminary negotiations for the building of the house were completed on Friday, April 20; necessary permits were obtained Saturday and on Monday, immediately after the formal breaking of the ground at noon by Secretary Herbert Hoover, construction was started. By night the footings were in, as there were no basement excavations. The end of the first week saw the walls up, the roof sheathed and the partitions in place for lathing.

Standard concrete block were used in laying up the walls and three coats of portland cement stucco were applied. The house was ready for occupancy, with plumbing, decorations and all equipment in place, exactly five weeks from the time the first spadeful of earth was turned in the excavation.

After serving its purpose as the feature of the Better Homes Movement during the year the house was donated to the Girl Scouts and moved to a lot near the Corcoran Art Gallery where it is being used as headquarters for the girl's organization.

The famous "Home, Sweet Home" house, built in Washington, D. C., by the General Federation of Women's Clubs.

House Plans for the Building Page

Pictures and plans of attractive homes furnish an ideal feature for the building page. Many newspapers have taken advantage of the house plan mat service of the Portland Cement Association, covering every type of dwelling.

PAGE TWELVE THE TIMES-UNION, ALBANY, N. Y., SATURDAY, FEBRUARY 2, 1924.

DON'T DELAY START THAT JOB NOW!

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Annual Supplies Needed by the Portland Cement Industry

THE following estimates of materials required by the Portland Cement Industry during 1923 are based on United States Geological Survey Reports of production for that year.

Fuel

Over 10,500,000 tons of coal were burned during 1923 in making the year's output of portland cement. Of this total, more than 7,000,000 tons were pulverized for burning in the kilns and, in a few cases, in the dryers. The remainder was used chiefly in generating power.

Over 4,700,000 barrels of fuel oil were burned during the year, chiefly in plants in California, Texas, Oregon, Kansas and Washington. Most of this was used in kilns and dryers.

Over 4,000,000,000 cubic feet of gas were consumed in cement mill operation during the year.

Sacks

Over 60,000,000 cloth sacks were lost or destroyed during the year. To replace these a strip of cloth over 34,000 miles long and 30 inches wide was needed. Most of these sacks were cotton, although some jute bags were used. Over 225,000,000 cloth sacks were in service in 1923.

Over 43,000,000 paper bags were used in shipping cement during the year, which is a large increase over 1922. In making these sacks about 16,000,000 pounds of paper were required.

Lubricants

Over 4,500,000 pounds of grease and 4,500,000 gallons of lubricating oil were used during the year at the cement mills. Combined this represents more than 38,000,000 pounds of lubricants.

Fire Brick

For relining cement kilns over 5,400,000 fire brick were needed.

Belting

Over 2,000,000 lineal feet of belting were worn out and had to be replaced during the year.

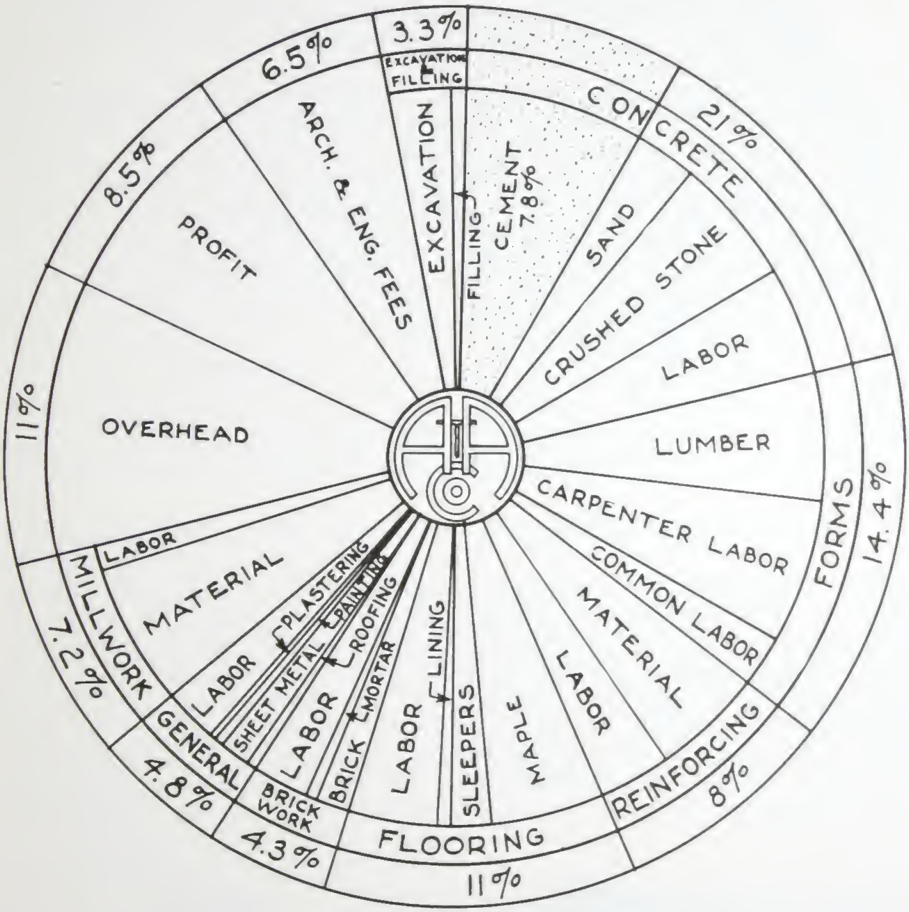
Dynamite and Other Explosives

Over 16,000,000 pounds of explosives were set off in cement quarries during the year.

Gypsum

For controlling the rate of hardening of cement when used over 725,000 tons of gypsum were ground up with the clinker.

How Much of a Concrete Building Is Cement?



Distribution of Construction Costs
of a
6-Story Reinforced Concrete Building of Mushroom Type
100′ 0″ by 170′ 0″

Overhead and profit is figured at 15 per cent and 10 per cent respectively on contractor's direct costs and architect's fees at 7 per cent on total, including overhead and profit.

Prices used in arriving at the percentage of distribution are average prices prevailing February 1, 1923.

(The above data is used through the courtesy of the American Appraisal Company, Milwaukee, Wisconsin.)

Concrete—and the City Beautiful

FROM "A New Art of Concrete"—an address delivered before the American Concrete Institute by Lorado Taft, world famous sculptor. These remarks were made in referring to "The Fountain of Time" in Washington Park, Chicago, originally executed in plaster by Mr. Taft and reproduced in concrete under his direction by John J. Earley of Washington, D. C.

"Most people, when one speaks of concrete, think of pavements and the color of a sidewalk, but here is something new which combines two very advantageous qualities in sculpture. We used to spend weeks in the Beaux-Arts days in Paris, after shaping a figure and modeling the flow of its surface, in going over it and putting little dabs of clay on it, you know, to get a little sparkle into it, a little vivacity—well, you don't have to do that any more. Just make it of this aggregate of pebbles and wash away the cement and you find your little dabs there; it has a wonderful effect. But more than that is the combination of colors which gives you a 'pointellist' painting. Mr. Earley took me into a vestibule in Washington—one of the most beautiful things I ever saw. You go up to it and feel of those moldings and they are hard and sharp—done with the firmest stroke, and yet from a distance they have almost the sparkle of a pen-and-ink drawing.

"I am telling you things that you know better than I do, but I wonder you don't go out and shout it from the housetops and get people interested. It is coming so slowly. One of our most intelligent art connoisseurs in Chicago said, 'I don't know but what we will be driven to using cement blocks in the university buildings'; but when I think of the possibilities of monolithic work which he does not know anything about yet, I am astonished at the inertia of humanity. I have had two wonderful experiences in the last two days. One was in that church which Mr. Earley has recently completed in Washington, the interior all in color. I do not know what that Byzantine decoration would cost in mosaic, but I'll guess this

Lorado Taft, world famous sculptor, designed the Fountain of Time, Washington Park, Chicago, which was reproduced in concrete under his direction by John J. Earley, architectural sculptor of Washington, D. C.

was not a tenth part of what the other method would cost. The mosaic maker will pick up his little stones with a forceps, perhaps, and lay them in. Mr. Earley apparently does it with a pepper box, but the result is beautiful. Yes, the results are perfectly marvelous in their vibrancy and harmony. I experienced some more thrills when I went down and saw another of Mr. Earley's jobs at Nashville.

"If I seem unduly enthusiastic about all this it is because I have had the opportunity of doing some large things in sculpture and know the difficulties of the work. If you knew how disappointing every artist's work is to him; if you could compare the dream he had and the result, you would know how humble we feel when we get through. And yet, how it is needed. This great country of ours is full of monotony, of arid, inartistic spots. My rich state of Illinois has four hundred towns of over a thousand inhabitants. Not many of them have places that one would care to take a friend from abroad to see because of anything man has created there. They compare so badly in that respect to European villages, with their wealth of historic association—towns where everything is picturesque and wonderful and interesting. Here in America people grow up and grow tired of their home-town and try to get away from it. As one of our novelists has put it, 'every train that goes through a country village tells of a promised land somewhere else; it is a cloud of smoke by day and a pillar of fire by night, alluring and inviting.' The youth of the country is led by this terrible drag, this tremendous gravitation toward the great city and you know what happens to them there.

"I think this is an unwholesome condition. I think there is something more important than the veneer of civilization, there is something vastly important in making the home town lovable and lovely for those who live there. Now by this new process it is possible that our home town shall have beautiful little fountains and monuments and decorations as exquisite in design as the world can produce and yet created at a comparatively small expense. That is why I am enthusiastic about this thing.

"It seems to me that we are on the verge of one of the greatest developments in American art."

Another view of the Fountain of Time. The design was suggested by the lines written by Austin Dobson—"Time goes you say; ah, no, Time stays, we go."

Standard Specifications for Portland Cement

IN the early days of the cement industry its quality standards were imported. A compilation of 91 cement specifications made in 1898 showed that scarcely two were alike. In many cases requirements were contradictory.

Through the efforts of the United States Bureau of Standards, a number of technical organizations, and the Portland Cement Association, a single standard cement specification was established in 1921. This standard is the highest in the world.

One of the by-laws adopted by the Portland Cement Association makes membership in the Association contingent upon the members' product meeting the requirements of the standard specification.

The Essentials of Good Concrete

EXCESS mixing water weakens concrete. Sloppy mixtures sacrifice strength. One pint more water than necessary in a one-bag batch decreases the strength and resistance to wear of concrete as much as if two or three pounds of cement had been left out.

Thorough mixing is essential to good concrete. Time of mixing, not speed of mixing, insures strength and quality. The mixing of each batch should continue for not less than 1 minute after all materials are in the mixer. The longer the better.

Good grading of aggregates increases the strength of concrete. In general, coarse sand will produce stronger concrete than fine sand while stone or pebbles in which the larger sizes predominate will produce stronger concrete than smaller ones.

Careful distinction should be made between the requirements of concrete for water during the mixing operation and during curing.

A safe rule to follow is to use the smallest quantity of mixing water that will produce a sufficiently plastic mixture for the work in hand, and then to give the surface of the concrete as much curing water as possible, after the concrete has been placed.

Concrete hardens because of chemical reactions between portland cement and water. It is not a drying out process. Concrete should be kept damp for at least ten days to secure best results. There is nothing that can be done to concrete that will pay such big dividends as proper use of water in mixing and curing.

LOCATION OF PORTLAND CEMENT PLANTS IN THE UNITED STATES